

## CLAIMS

What is claimed is:

1. A method of operating an electrolyzer system having an electrolyzer comprising a container housing a first side which is one of an anode side wherein an oxygen-containing stream is produced and a cathode side wherein a hydrogen-containing stream is produced and a second side which is the other of the anode side and the cathode side, the method comprising:

(a) positioning the container in an interior cavity of a pressure vessel;

(b) pressurizing water in said interior cavity of said pressure vessel;

(c) supplying said pressurized water to the first and second sides within the container;

(d) supplying electrical current to the electrolyzer; and

(e) producing the hydrogen-containing stream in the cathode side and the oxygen-containing stream in the anode side from said current and said pressurized water.

2. The method of claim 1, further comprising:
  - (f) routing a first side stream produced in the first side out of said pressure vessel; and
  - (g) routing a second side stream produced in the second side into said interior cavity.
3. The method of claim 2, wherein routing said first side stream further comprises selectively allowing said first side stream to be routed out of said pressure vessel with a valve.
4. The method of claim 3, further comprising regulating a pressure of said first side stream with said valve.
5. The method of claim 2, wherein routing said first side stream further comprises routing said first side stream to a separator and the method further comprises:
  - (h) separating said first side stream into at least a gas and liquid water;
  - (i) selectively routing said liquid water from said separator to said interior cavity; and
  - (j) selectively routing said gas from said separator to a downstream component of the electrolyzer system.

6. The method of claim 5, wherein said downstream component accumulates said separated gas and said pressurized water is at least partially pressurized by back pressure of said accumulated gas.

7. The method of claim 2, wherein the first side is the cathode side, said first side stream is the hydrogen-containing stream, the second side is the anode side, and said second side stream is the oxygen-containing stream.

8. The method of claim 2, wherein said water is at least partially pressurized by evolved gas in said second side stream being selectively retained in said interior cavity of said vessel.

9. The method of claim 1, wherein pressurizing water in said interior cavity comprises pressurizing said water in said interior cavity to greater than about 5,000 psi.

10. The method of claim 9, wherein pressurizing water in said interior cavity comprises pressuring said water in said interior cavity to greater than about 10,000 psi.

11. The method of claim 1, wherein said water is pressurized by a high pressure water pump.

12. The method of claim 1, wherein supplying said pressurized water to the first and second sides comprises pumping said pressurized water to the first and second sides with a pump located in said interior cavity.

13. The method of claim 1, wherein supplying said pressurized water to both of the sides of the electrolyzer further comprises controlling a rate at which said pressurized water is supplied to at least one of the sides.

14. The method of claim 1, further comprising monitoring a level of said pressurized water in said interior cavity and selectively supplying water to said interior cavity based on said level of said pressurized water in said interior cavity.

15. The method of claim 1, further comprising monitoring a pressure in said interior cavity and wherein pressurizing water in said interior cavity further comprises pressurizing said water based on said pressure in said interior cavity

16. The method of claim 1, further comprising selectively venting a gas in said interior cavity out of said pressure vessel.

17. The method of claim 1, further comprising maintaining a pressure difference between the anode and cathode sides of the electrolyzer to less than about 2,000 psi.

18. The method of claim 1, wherein the container is submerged in said pressurized water.

19. An electrolyzer system comprising:

a pressure vessel having an interior cavity;

an electrolyzer having a first side which is one of an anode side and a cathode side and a second side which is the other of said anode and cathode sides, said electrolyzer operable to convert water and electricity into a hydrogen-containing stream on said cathode side and an oxygen-containing stream on said anode side, said electrolyzer located in said interior cavity of said pressure vessel;

a pressurized water source operable to selectively supply pressurized water;

a flow path from said pressurized water source to said interior cavity of said pressure vessel, said interior cavity receiving pressurized water from said pressurized water source via said flow path and said pressurized water pressurizing said interior cavity of said pressure vessel; and

wherein said pressurized water in said interior cavity of said pressure vessel is supplied to both sides of said electrolyzer and said electrolyzer uses said pressurized water along with an electrical current to produce said hydrogen-containing stream and said oxygen-containing stream.

20. The system of claim 19, wherein each side of said electrolyzer has an inlet and an outlet, each inlet receiving said pressurized water from said interior cavity, side first side outlet being connected to a flow path that routes a first side stream out of said pressure vessel, and said second side outlet routing a second side stream into said interior cavity.

21. The system of claim 20, further comprising a valve in said flow path from said first side outlet, said valve selectively allowing said first side stream to flow from said first side through said flow path out of said pressure vessel.

22. The system of claim 21, wherein said valve regulates a pressure of said first side stream.

23. The system of claim 21, further comprising a separator located in said flow path between said first side outlet and said valve, said separator separating said first side stream into at least a gas and liquid water, said separator having a first outlet through which said gas flows and a second outlet through which said liquid water flows, and said second outlet is connected to a flow path that directs said liquid water into said interior cavity of said pressure vessel.

24. The system of claim 19, further comprising a pump located in said interior cavity of said pressure vessel, said pump having an inlet communicating with said pressurized water in said interior cavity, an outlet communicating with inlets on each side of said electrolyzer, and said pump selectively supplies said pressurized water in said interior cavity to each side of said electrolyzer.

25. The system of claim 19, wherein said source of pressurized water is a high pressure water pump.

26. The system of claim 19, wherein said first side is said cathode side and said second side is said anode side.

27. The system of claim 19, wherein said pressurized water supplied to at least one side of said electrolyzer is regulated.

28. The system of claim 19, further comprising a level indicator indicating a level of said pressurized water in said interior cavity and wherein said pressurized water source selectively supplies said pressurized water based on said level of said pressurized water.



29. The system of claim 19, further comprising a pressure indicator indicating a pressure in said interior cavity and wherein said pressurized water source selectively supplies said pressurized water based on said pressure in said interior cavity.

30. The system of claim 19, further comprising:

a flow path from an upper portion of said interior cavity out of said pressure vessel through which gas in said upper portion can flow; and

a valve in said flow path from said upper portion, said valve selectively allowing said gas to flow through said flow path and out of said pressure vessel.

31. The system of claim 19, wherein said valve and said source of pressurized water control a pressure in said interior cavity.

32. The system of claim 19, wherein said interior cavity is pressurized to greater than about 5,000 psi.

33. The system of claim 19, wherein said interior cavity is pressurized to greater than about 10,000 psi.

34. The system of claim 19, wherein a pressure difference between said anode and cathode sides is less than about 2,000 psi.

35. The system of claim 19, wherein said electrolyzer is submerged in said pressurized water in said interior cavity.

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36. A method of operating an electrolyzer system having an electrolyzer with a first side which is one of an anode side wherein an oxygen-containing stream is produced and a cathode side wherein a hydrogen-containing stream is produced and a second side which is the other of the anode said and the cathode side, the method comprising:

- (a) positioning the electrolyzer in an interior cavity of a pressure vessel;
- (b) pressurizing said interior cavity of said pressure vessel;
- (c) supplying water to the first and second sides of the electrolyzer;
- (d) supplying an electrical current to the electrolyzer;
- (e) producing the hydrogen-containing stream in the cathode side and the oxygen-containing stream in the anode side from said current and said water; and
- (f) regulating a pressure in the first side of the electrolyzer by selectively venting a first side stream produced in the first side of the electrolyzer out of said pressure vessel and into a pressurized storage device through a closed-loop regulator that compares said pressure in the first side of the electrolyzer with said pressure in said storage device.

37. The method of claim 36, further comprising:  
routing said first side stream to a separator;  
separating said first side stream into liquid water and a gas; and  
wherein regulating said pressure in the first side further comprises  
selectively venting said gas in said separator to said pressurized storage device.

38. The method of claim 37, further comprising selectively routing said  
liquid water in said separator to said interior cavity of said pressure vessel.

39. The method of claim 36, further comprising:  
selectively supplying pressurized water to said interior cavity of said  
pressure vessel;  
pressurizing said interior cavity of said pressure vessel with said  
pressurized water; and  
wherein supplying water to the first and second sides of the  
electrolyzer comprises supplying said pressurized water in said interior cavity of  
said pressure vessel to the first and second sides of the electrolyzer.

40. A method of operating an electrolyzer system having an electrolyzer with a first side which is one of an anode side wherein an oxygen-containing stream is produced and a cathode side wherein a hydrogen-containing stream is produced and a second side which is the other of the anode side and the cathode side, the method comprising:

(a) positioning the electrolyzer in an interior cavity of a pressure vessel;

(b) selectively supplying water to said interior cavity of said pressure vessel;

(c) supplying said water in said interior cavity to the first and second sides of the electrolyzer;

(d) supplying an electrical current to the electrolyzer;

(e) producing the hydrogen-containing stream in the cathode side and the oxygen-containing stream in the anode side from said current and said water; and

(f) exhausting a first side stream containing liquid water and a gas produced in the first side of the electrolyzer into said interior cavity where said liquid water from said first side stream joins with said water in said interior cavity and is recirculated through one of the first and second sides of the electrolyzer as part of said water being supplied to the first and second sides of the electrolyzer.

41. The method of claim 40, wherein selectively supplying water to said interior cavity comprises selectively supplying pressurized water to said interior cavity and further comprising pressurizing said interior cavity with said pressurized water.

42. The method of claim 40, further comprising regulating a pressure in the second side of the electrolyzer by selectively venting a second side stream produced in the second side out of said pressure vessel and into a pressurized storage device.